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DEPARTMENT OF COMMERCE

TECHNICAL NEWS BULLETIN
OF THE BUREAU OF STANDARDS

Subscription, 25 cents a year (U. S.), 40 cents a year (Foreign). Address "Superintendent of Documents, Washington, D. C."

Washington, February, 1927—No. 118

BRICK-WALL INVESTIGATION

During the year 1926 the bureau, in cooperation with the Common Brick Manufacturers Association of America, has been conducting a series of tests on brick masonry which, from the size and number of test specimens and control and measurement of variables, is noteworthy and unique.

While brick masonry is one of the oldest recorded types of construction, there has been practically no data upon which to erect standards. This lack of fundamental information is probably largely responsible for the present unsatisfactory state of specification writing as applied to brick and the wide variation in building-code requirements concerning brick masonary.

The investigation may be considered as divided into two sections. The first section consists of an investigation of the properties of individual bricks. These bricks are representative of four types of commercial production and are believed to be typical. Information gained from the results of this work has been made use of already by one of our national societies devoted to standardization. The second section consists in the construction and test of walls as hereinafter described. The results obtained from the individual tests, correlated with the results obtained from the masonry tests, give information directly applicable to the formulation of standards and specifications for brick.

The program consists of tests on 153 walls, divided into four series. The variables consist of 2 types of workmanship, 4 kinds of clay brick, 3 kinds of mortar, and different types of construction covering 8 and 12 inch solid walls and the various 8 and 12 inch hollow walls used by the Common Brick Manufacturers Association. Tests on the association's 4-inch economy wall are also included.

The results secured from the tests on hollow walls of brick will be of interest because they will help to answer the question as to whether the traditional solid masonry may not be in part replaced by a wall which will permit a more economical utilization of the material.

The two types of workmanship have several distinctive features, the chief one being the practical absence of vertical joint filling for the walls in series 1 as against complete filling of joints in series 2, 3, and 4. Series 1 was constructed by contract, to secure a grade of workmanship comparable to uninspected commercial work. Series 2, 3, and 4 are constructed by day labor with rather careful supervision. However, no laboratory refinements are introduced for the walls.

The mortars are a 1:3 lime-sand, a 1:1:6 lime-cement-sand, and a 1:3 cement-sand, all by volume, though the actual mixing is by weight, correction being made for the moisture content of the sand. In series 2, 3, and 4 an amount of hydrated lime equal to 10 per cent by volume of the cement is added to the 1:3 cement-sand mortar. It was originally intended to have the four grades of brick (one for each series) correspond to the four grades specified by the American Society for Testing

Materials, viz, soft, medium, hard, and vitrified. On testing the brick it was found that they graded as follows:

Brick for—	A. S. T. M. grade in—		
	Compression	Modulus of rupture	Absorption
Series 1	Medium	Vitrified	Medium.
Series 2	do	Hard	Soft.
Series 3	Hard	do	Do.
Series 4	Vitrified	Vitrified	Hard.

In addition to the tests made to determine the A. S. T. M. grade, additional tests were made for tensile strength and strength in shear, and for absorption without boiling, and for rate of absorption.

The walls are 6 feet long by approximately 9 feet high and of nominal thickness of 4, 8, and 12 inches, depending upon the type of construction. For each wall a corresponding small wall or wallette, 18 inches long by 34 inches high, is built. The walls are tested by loading concentrically to the maximum in the 10,000,000-pound compression machine. Strain measurements are taken both horizontally and vertically. On some walls readings are taken for repeated application of load.

At the time of writing the investigation is incomplete, hence only the most general and obvious conclusions can be drawn:

1. Using brick of the same grade and the same construction, walls having all joints filled give greater strength than walls with open joint work.

2. On solid walls, the stronger the mortar the greater the strength of the wall.

3. For solid walls the strength of the wall depends upon the strength of the brick; the stronger the brick the stronger the wall.

4. Uniformity in the size and the shape of the individual bricks has a bearing on wall strength.

5. The transverse strength of the brick has no definite relation to wall strength for any type of construction.

6. The ratio between the ultimate stress (lbs./in.^{2}) in the large walls and the wallettes is not constant for different types of construction.

RATE OF DRYING OF WALL PLASTERS

It has been long recognized by interior decorators, plasterers, and paper hangers that freshly plastered walls and ceilings must be thoroughly dry before they can be decorated successfully. As a superficial examination of a plaster can not be depended upon to disclose with any degree of accuracy the percentage of water remaining in the plaster, it was decided to determine the time required for drying of those types of plaster in common use under different conditions of temperature and humidity.

Panels of plaster about 4 by 6 inches and held in wooden frames are suspended from a balance arm by means of a wire which passes through a small hole in the top of a cabinet. The loss in weight of the plaster through evaporation of water is recorded, and the plaster is considered dry when its weight remains constant over a period of 24 hours. Air is provided through a suitable opening in the cabinet at a constant velocity of 80 cubic inches per minute. Constant temperature is maintained by a thermostatic regulator.

Determinations have been made at temperatures 22, 30, and 37° C. (71.6, 86.0, and 98.6° F.), using air of about 65 and 95 per cent relative humidity. The proposed program calls for another series of measurements at 15° C. (59° F.), which has not yet been completed. The following plasters have been tested:

Kind of plaster	Coats	Thickness	Finish
		Inches	
Gypsum	2	1/2	Sand float.
	2	1/8	Do.
	3	1/2	White.
	3	1/8	Do.
	(1)	1 3/4	Sand float.
Lime	(2)	(2)	(2)
Cement	2	1/2	Sand float.
	2	1/8	Do.
	(1)	1 3/4	Do.

[1] Back plastered, 2-coat.
[2] Same as gypsum.

The mixes used conformed to the recommendations of the American Society

for Testing Materials for gypsum plasters, the National Lime Association for lime plasters, and the Portland Cement Association for cement plaster.

The work completed indicates that the temperature of the surroundings exerts the greatest influence upon the time required for drying of plaster. Thus a one-half-inch, two-coat, sand float finish, gypsum plaster has been found to dry to approximately constant weight at 22° C. (71.6° F.) with air of 65 per cent humidity in 80 hours; at 30° C. (86° F.) the drying time is reduced to 40 hours, and at 37° C. (98.6° F.) to 25 hours. Approximately the same ratio holds true for other thicknesses and other plasters. Increasing the humidity materially prolongs the drying time. Thus from 125 to 200 hours more time is required for "drying" of similar plasters at 95 per cent relative humidity than is necessary at 65 per cent humidity, with the same temperature in each case. The time of drying also varies almost directly as the thickness of the plaster. The three-coat plasters dry somewhat slower than do two-coat plasters of the same thickness dried under similar temperature and humidity conditions. This phenomena is probably due to the slower rate of diffusion of water through the comparatively dense white finish coat which is applied to the three-coat specimens.

It is believed that the data which will be available upon completion of this work will enable decorators to proceed with increased confidence upon the task of painting or papering plastered walls.

TESTING MINE STOPPINGS

Results of tests on plain and reinforced concrete mine stoppings (partially described in Technical News Bulletin No. 116) employed to prevent explosions penetrating from one portion of a mine to another indicate that conditions in the mine will largely govern the design. Where it is possible to obtain solid abutments for taking heavy arch thrusts, plain concrete stoppings may be employed having thicknesses little greater than reinforced stoppings. On the other hand, conditions may arise where the stoppings have to be designed as simply supported or partially restrained slabs, in which case the steel reinforcement should be carried well into the grooves cut in the sides of the mine opening.

The slabs were subjected to explosive charges of black powder in a specially designed chamber. Both plain concrete slabs and slabs reinforced with steel in varying amounts and in various shapes were tested. The slabs were 5 feet square and either 8 or 12 inches thick. The pressures acted on a surface 4 feet square.

All the stoppings were tested as simply supported with the exception of one 8-inch plain concrete stopping, which was tested for arching strength by partially restraining the ends against lateral expansion.

Briefly, the results obtained are as follows: An 8-inch stopping with 0.5 per cent steel reinforcement failed under an explosive pressure of 50 lbs/in.^{2} by tension in the steel. The average pressure of five 8-inch stoppings with 1.0 per cent reinforcement was 100 lbs./in.^{2}. Failure in each case was by tension in the steel. A 12-inch plain concrete stopping failed by tension in the concrete under an explosive pressure of 44 lbs./in.^{2}, while an 8-inch plain concrete stopping tested for arching strength failed under 146 lbs./in.^{2} by compression in the concrete at the center of the span.

From these tests the following conclusions were drawn:

1. Stresses produced in concrete stoppings by explosive charges of black powder are the same as those produced by static forces of the same magnitude.

2. Under explosive pressures which are quickly released or carried to the breaking point, concrete stoppings are capable of carrying higher stresses than if the pressures are slowly applied.

3. Plain concrete stoppings will safely and economically withstand explosive pressures where solid abutments are available for taking heavy thrusts and where the construction is such that the shrinkage of the concrete is not appreciable.

Since the same stresses are produced by equal static and explosive forces, mine stoppings should be designed for the maximum explosive pressures which the stoppings are expected to withstand by the same formulas which are applicable to static loads. Somewhat higher working stresses may be employed because of the short duration of maximum pressure.

Stoppings may be constructed by pouring concrete across the opening and into notches cut into the sides of the mine. Thus constructed they are capable of carrying additional loads because of the arching action. How much additional load can only be guessed, since the yielding of the abutments will vary with the condition of the coal and the shrinkage of the concrete on hardening. If these factors were known, the additional loads due to arching action could be taken into account. Under favorable conditions the arching action may be such that plain concrete stoppings could carry explosive pressures with consequent economies in construction. However, where conditions require steel reinforcement the use of higher permissible working stresses will effect considerable economies.

REMOVAL OF STAIN FROM MARBLE

The work of developing practical methods of removing various kinds of stain from marblework has resulted in fairly successful means of removing the more usual and troublesome stains found on interior marble. Methods for treating iron, tobacco, and ink stains have been previously described. More recently methods for treating oil stains, copper or bronze stains, fire stains, and general service stains have been developed.

Stains from linseed oil and lubricating oil are often very hard to remove unless the stained part of the marble can be heated, and in some parts of a building this may not be feasible. For linseed-oil stains mix equal parts of wood alcohol and a 10 per cent solution of trisodium phosphate. Saturate a layer of cotton in this mixture and paste it over the stained part of the marble. When the cotton is dry repeat the operation. Several applications may be necessary. Wherever it is practical to use the following method more speedy results will be obtained: Make a poultice of asbestos fiber and the solution mentioned above. Plaster a layer about one-fourth inch thick over the stain. Cover the poultice with a scrap slab of marble and place on this a hot smoothing iron of about the temperature used for ordinary pressing.

Lubricating-oil stains may be removed by saturating a layer of cotton in a mixture of equal parts acetone and amyl acetate, pasting this over the stain and covering with a scrap slab of marble. Several such applications may be necessary. A more expedient means which may be used in many cases is to make a poultice of asbestos fiber and amyl acetate. Plaster a one-fourth-inch layer of this over the stain, cover with a scrap slab of marble, and apply a hot iron as described above.

Green stains which form on marble around copper or bronze work may be removed as follows: Dissolve 1 part of ammonium chloride in 4 parts of powdered talc. Add ammonia water and mix to a stiff paste. Apply a one-half-inch layer of this over the stain and leave until thoroughly dry. Deep stains may require a few repetitions of the process. Usually a small amount of the green stain will remain in the marble and prove difficult to remove by this method. Such can be overcome by applying a layer of cotton saturated in a weak solution of potassium cyanide. It should be remembered that potassium cyanide is a very active poison and should be handled with extreme care.

A poultice treatment that is satisfactory for use on general service stains, such as may occur on marble that has not received proper attention, is as follows: Dissolve 1 pound of trisodium phosphate in 1 gallon of warm water. Mix three-fourths pound of chlorinated lime to a paste by adding water slowly and mashing the lumps. Combine the trisodium phosphate solution and paste and add water to make 2 gallons. Stir thoroughly and keep it in a covered

stoneware jar. Add enough of this mixture to powdered talc to form a paste of mortar consistency. Plaster this over the stained marble and leave it until dry, then scrape it off with a wooden paddle.

A very stubborn type of stain is sometimes found on marblework caused by pine wood burning in contact with the marble. This can be removed by means of the trisodium phosphate and chlorinate lime mixture mentioned above. In treating this type of stain it is best to soak a layer of cotton in the solution and paste it over the stain. Several repetitions may be necessary. The action may be greatly accelerated by using the hot iron as described under the linseed oil treatment. In this case asbestos fiber should be used instead of a layer of cotton.

A more complete description of these methods will be found in the January, 1927, issue of the journal Through the Ages.

MICROSTRUCTURE OF EARTHENWARE

The investigation of the crazing of so-called "semivitreous" earthenware carried on cooperatively with the United States Potters' Association included a study of the microstructure of the ware with the petrographic microscope. While the results of this study could not be satisfactorily correlated with the crazing of the ware, certain relations between microstructure within the body and at the contact of body and glaze were revealed. A report on this study has been prepared for publication.

Nineteen samples of glazed earthenware bodies varying in composition or in firing treatment were examined microscopically in thin sections, and photomicrographs of many of the sections at a magnification of 600 diameters were taken. Particular attention was paid to the size of the mullite crystals formed under different burning conditions within the body and at the body-glaze contact.

Ratings in a scale of 8 were assigned to each of the samples according to the relative growth of mullite within the bodies. The sample having a value of 1 in the scale was the sample showing the smallest mullite needles, while the sample with the value of 8 had the longest mullite needles. The maximum length of mullite needles at the body-glaze contact was also determined for each sample. An inspection of the values thus assigned showed that there was a marked relation between the maximum size of mullite needles at the contact and the rating of the sample in the scale of mullite growth within the body.

The following observations were made: (1) That mullite crystals at the contact of body and glaze grew out from the body into the glaze in a position approximately normal to the contact; (2) that mullite crystals at the contact were always larger than those within the body proper; (3) that, in general, the greater the heat treatment in the firing of the unglazed ware the longer the mullite crystals both within the body and at the contact.

SOLID SOLUTION IN THE SPINEL MINERALS AND ITS RELATION TO THEIR USE IN REFRACTORIES

The compound $MgO–Al_2O_3$, or the magnesium spinel, has certain properties which are very desirable from the standpoint of a refractory material. It has a high melting point, is neutral or basic chemically, and consequently has a low solubility in those silicate melts which are high in magnesia and alumina. However, this compound at high temperatures readily forms solid solutions with various oxides, such as iron, cromium, and aluminum. This causes variation in its chemical and physical properties and is a serious objection to its use as a refractory.

An investigation to study the above phenomena and attempt to find some of the fundamental relations governing solid solution in this important group of minerals is being carried on cooperatively between the Bureau of Standards and the Engineering Experiment Station of Ohio State University. The methods used in this work are:

1. Tracing the degree of solid solution in the minerals of the system through

determination of the changes in their indexes of refraction.

2. Detection of the presence of new crystal phases by means of the X ray.

3. Determination of the chemical changes taking place by chemical analysis.

The work thus far indicates the following relations:

1. That periclase (MgO) readily forms solid solutions with iron oxide at high temperatures.

2. That iron oxide also passes into solution in magnesian spinel at high temperatures, and in so doing has a pronounced bonding effect upon mixtures of the two. The iron oxide in solid solution at high temperature tends to precipitate out or segregate itself under certain conditions which are being further studied.

3. Magnesio-ferrite ($MgO–Fe_2O_3$), also one of the spinel groups, is red and transparent, in thin section, after having been cooled slowly from cone 26, 1,595 °C. (2,903 °F.). If, however, it is quenched in water from this temperature it becomes black and opaque. This is being studied in an attempt to determine whether a change in state takes place under these conditions.

STATISTICS AND ECONOMICS OF BUILDING IN 1926

The total contracts awarded for new building construction during the entire year 1926 exceeded those for 1925, according to reports of the F. W. Dodge Corporation. The total for 36 Eastern States for 1926 was $6,117,502,900, against $5,821,068,400 for 1925, a gain of 5.7 per cent.

The total contracts awarded for new building construction during the month of December, 1926, for the 36 Eastern States just referred to, were the largest ever recorded for the month of December, reaching a total of $520,107,200. The corresponding figure for December, 1925, was $510,868,400. December, 1926, showed a marked falling off, as compared with December, 1925, in contracts awarded for educational and residential buildings, but large gains in awards for industrial buildings, public buildings, public works, and utilities.

Comparing the classes of construction for the entire year, it is found that 1926 shows a gain over 1925 in all groups, except educational, religious, and memorial buildings, residential construction, and social and recreational building, in each of which groups the 1926 total falls slightly below the corresponding figure for the preceding year.

The wholesale and retail prices of building materials showed a slight downward trend in November and December, and the monthly average for 1926 was slightly under that for 1925. Very little change occurred in the construction cost indexes which included the item of labor as well as material, the monthly average for these for 1926 being 208 and 197, as compared with 207 and 195 in 1925.

STANDARD STATE MECHANICS' LIEN ACT

The tentative draft of the "standard State mechanics' lien act," prepared under the auspices of the division of building and housing, was printed privately by the committee in charge of the work, and more than 6,000 copies have been distributed to organizations and individuals especially interested in its provisions. Comments and criticisms have been sought from many whose interests are affected by legislation of this kind and whose experience and knowledge of the practical working of mechanics' lien laws place them in a position to be of assistance to the committee in perfecting the act. These comments and criticisms are now practically complete and will be ready for presentation to the committee for consideration at the meeting early in February.

A PRIMER OF SIMPLIFIED PRACTICE

The growing interest of our industries in the principles of simplified practice has been marked by a steadily increasing volume of requests for information as to the purposes, methods, and accomplishments of this branch of the waste-elimination work of the Department of Commerce.

These inquiries have shown a tendency to classify themselves in certain directions. With this in mind, a Primer of Simplified Practice has been prepared, which provides answers to typical questions, based on the experience of the past five years. The entire staff of the division of simplified practice has collaborated, and further contribution has been made by the executives of trade associations and others whose experiences with simplified practice have been of peculiar interest and value.

Copies of the primer will be sent to those interested upon application. It is hoped that the pamphlet will fill a real need, and any suggestions for improvements in future issues will be gladly received. If you feel that some important phases of the general subject have been omitted or need more detailed treatment, do not hesitate to give the division the benefit of your opinion.

ACTIVITIES OF NATIONAL COMMITTEE ON METALS UTILIZATION

The status of the committee's active projects is as follows:

Metal Spools and Reels.—On December 2, 1926, manufacturers of metal spools and reels, representing approximately 90 per cent of the annual production of these commodities, convened at the Department of Commerce under the auspices of the National Committee on Metals Utilization for the purpose of considering the possibilities of applying the principles of simplified practice to their products.

A committee was appointed to conduct a survey of the present conditions in the industry as a first step in the direction of framing a tentative simplified practice recommendation. On January 15 the chairman of the Simplified Practice Committee made a report of the results of this survey to the National Committee on Metals Utilization.

Automotive Industry.—Early in February, in Detroit, Mich., there were four general conferences of manufacturers, distributers, and users for the purpose of considering the tentative programs of the Society of Automotive Engineers and of developing unanimous simplified practice recommendations covering (1) spark plugs, (2) pistons and piston rings, (3) brake lining, and (4) roller bearings. These meetings were held under the auspices of the National Committee on Metals Utilization.

Flashlight Industry.—At a meeting in New York City, December 9 (under the auspices of the Department of Commerce), the Simplified Practice Committee of the Flashlight Industry made further progress in its survey of existing overdiversification.

Wrought-Iron and Wrought-Steel Pipe, Valves, and Fittings.—Simplified Practice Recommendation No. 57, Wrought-Iron and Wrought-Steel Pipe, Valves, and Fittings, which makes possible a 21 per cent reduction in the variety of pipe sizes, is now ready for distribution.

ACTIVITIES OF THE NATIONAL COMMITTEE ON WOOD UTILIZATION

The status of the committee's active projects is as follows:

Uses for Short Lengths in Building and Construction.—A bulletin, entitled "The Marketing of Short-Length Lumber," containing 32 pages, is now ready for distribution. Orders for several thousand copies of this bulletin have already been received by the Government Printing Office, as many trade associations are distributing these bulletins to their members and the latter are using them as inclosures with sales letters. Copies of this report can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of 10 cents per copy.

End Matching of Softwood Lumber.—This project was started during the month of December. A subcommittee of 11 members, headed by William F. Chew, managing director, The Builders' Exchange of Baltimore City, Baltimore, Md., is handling this project. The preliminary draft of the bulletin has been prepared, and it is expected that the report will be ready for the printer within a few weeks. The end matching of softwood lumber is still in the first stages, and it is believed that this bulletin will

effectively contribute to the promotion of the use of this material. The end matching of lumber is one of the most outstanding accomplishments in the wood utilization field.

Seasoning and Handling of Lumber.—The four subcommittees representing lumber manufacturers, distributers, fabricators, and consumers, are now assembling the necessary material for their respective bulletins, and the committee's staff in Washington is concentrating its efforts on this project which, at the present time, is considered the most important of the committee's activities. An arrangement has been made with the United States Forest Service, and other institutions, in regard to active cooperation on this project.

Wood Distillation.—A comprehensive report on wood distillation, which has already been pronounced as the most complete of its kind written in the English language, has been prepared by William K. Ljungdahl, chemical engineer, whose services were made available to the committee by the Department of Commerce. The report contains valuable data in regard to the best practices of wood distillation, both in the United States and abroad. As soon as the members of the Wood Chemicals Subcommittee have passed on this report the bulletin will go to the printer.

Wood Preservation.—A preliminary investigation of the question of retail distribution of preserved wood is being made by the committee. As a consequence, this treated wood, seldom handled by the retailer, will be more readily available to the average lumber consumer.

Small Dimension Stock.—The establishment of the Dimension Lumber Manufacturers' Association, during November, gave the committee the benefit of dealing with an organized group of small dimension producers. At the meeting of the association in January plans for close cooperation with the Department of Commerce were made.

Veneer and Plywood.—Negotiations between the Veneer and Plywood Subcommittees and a Special Radio Cabinet Committee of the Radio Manufacturers' Association are now being carried on in regard to standardization of sizes of radio-cabinet panels. The success of this project will mean much in the elimination of waste, both in the producing and consuming industries.

Containers.—At the meeting of the executive committee of the National Committee on Wood Utilization held in Washington, November 23, 1926, it was decided that the Container Subcommittee should be separated into two distinct groups, one for wooden containers and the other for fiber containers, in order to permit the two groups to develop their projects independently of each other. At the invitation of the Fifth National Exposition of Power and Mechanical Engineering the two groups exhibited, from December 6 to 11, at the Grand Central Palace, New York, N. Y., a series of container types showing scientific design and construction. The exhibit attracted considerable attention, and plans are now being considered for a traveling exhibit to cover more than 40 cities in the United States that have expressed an interest in this project.

REDUCING INVENTORIES

"If you can not apply simplification to things you sell, then apply it to things you buy? Don't buy 15 varieties of bolts, if by study you can make one kind of bolt satisfy the 15 uses." The hotel manager who made this statement reduced his cost of items simplified 20 per cent below their former cost, released $350,000 from former inventories, and saved $100,000 a year.

A well-known eastern railroad cut its supply list from 140,000 to 78,000 items. Another road eliminated 4,936 items, another 5,457, and a third over 7,000. One carrier cut its average stores investment from $38,000,000 to $20,000,000—largely through simplifying its requirements.

The cost of carrying inventories includes much more than interest on investment. Rent, insurance, taxes, transportation, handling and distribution, depreciation, and obsolescence all have to

be taken into account. In some lines the average "cost-to-carry" is 15 to 25 per cent of the value of the inventory. It may exceed this in other fields.

Many companies have just completed their annual inventories. Now is a good time to study the possibilities for their reduction through simplification. The savings through release of otherwise idle inventory investment are usually great enough to make such study very profitable. The ideal situation exists when all the inventory is in process or in transit—in other words, "on the move." Simplification affords an easy approach to this ideal, for it is based on the elimination of excessive or superfluous variety—the chief source of idle investment and heavy costs of inventory maintenance. If you can not apply simplification to things you sell, then "why not apply it to things you buy?"

"NORMAL" AND "ABNORMAL" STEEL

The process of casehardening, a very old one in the metallurgy of steel, has come into very wide use in recent years in the automobile industry. In casehardening, the outside of a relatively soft steel article is impregnated with carbon, which makes it possible, by suitable quenching, to obtain a hard wearing surface, whereas the interior remains tough and ductile.

The process of casehardening or carburizing is somewhat complicated, and a good many difficulties arise in the plant at times. One of the most serious is soft spots on the finished surface. Recently the metallurgist of a roller-bearing company reported that certain grades of steel which he called "abnormal" are more prone to give this trouble than "normal" or ordinary steel. The difference between the two types of steel is revealed by microscopic examination after carburization of the steel and can not be detected with certainty in the steel in its initial condition either by microscopic examination or by chemical analysis. This conclusion that the kind of steel used may be responsible for soft spots has not been accepted by all metallurgists.

During the year a study of this problem was finished at the bureau, and the results have clearly shown a very noticeable difference in the microstructure of steels after carburizing, both in low-carbon steels, such as are used for case-hardening work, and in high-carbon tool steels. The terms "normal" and "abnormal" have been retained, for want of better ones, to designate this difference in the structural condition.

The results of the investigation have shown that the "abnormal" steel is more prone to surface soft spots after the hardening treatment than is the usual grade of steel.

Aside from the tendency to give soft spots, however, the abnormal type is not inferior to the normal and for some purposes may even be superior. It was shown that both types of steel harden satisfactorily if the quenching is done at a sufficiently rapid rate; for example, the use of brine solutions and the like. This is not always feasible in commercial practice, however. Incidentally, it was brought out that air dissolved in the quenching water has a detrimental effect and contributes to the unsatisfactory results in the hardening of steel in general. The origin of normality and abnormality was found to lie in the deoxidation treatment during the refining of the steel. Additions of aluminum in the ingot molds caused abnormality of an otherwise normal steel.

THERMAL EXPANSION OF BERYLLIUM

Data on the linear thermal expansion of beryllium between —120 and +700° C. have recently been obtained. The rod investigated was prepared by the Beryllium Corporation of America and was found to have a density of 1.835 grams per cubic centimeter at 20° C. The coefficients or rates of expansion at —110 and +650° C. are 5×10^{-6} and 20×10^{-6}, respectively. Beryllium expands considerably less than the other elements of subgroup II B (Mg, Zn, Cd, and Hg).

Average coefficients of expansion for various temperature ranges are given in the following table:

Average coefficients of expansion per degree centigrade

Temperature range	Coefficient of expansion	Temperature range	Coefficient of expansion
° C.	$x\ 10^{-6}$	° C.	$x\ 10^{-6}$
−100 to −50	7.0	+20 to +300	14.0
−120 to +20	8.1	+20 to +400	14.8
−50 to +20	9.8	+20 to +500	15.5
+20 to +100	12.3	+20 to +600	16.1
+20 to +200	13.3	+20 to +700	16.8

Additional details on beryllium and some aluminum-beryllium alloys will be published later.

RESEARCH ON "SPOTTING OUT" OF ELECTROPLATED FINISHES

During the past year the American Electroplaters' Society has been engaged in collecting from manufacturers funds to be used for cooperative researches on electroplating at the Bureau of Standards. Their goal is to obtain a fund of $10,000 per year for three years, based on contributions of $50 or more per year from each subscribing firm. To date about $4,000 per year has been raised, and the campaign is being continued by their Research Committee, of which R. J. O'Connor, 1228 Noble Avenue, Bridgeport, Conn., is chairman.

W. P. Barrows, formerly of the bureau staff, has been appointed as a research associate on this fund and is just starting out on an investigation of the causes and prevention of "spotting out" of electroplated finishes. This difficulty is especially experienced with the so-called "oxidized" finishes on such articles as builders' hardware and lighting fixtures, which consist of iron or steel, plated with copper or brass, treated with a sulphide solution, and finally lacquered. The defect is, however, also occasionally observed on silver or gold plated articles, and even on solid brass that has not been plated.

In company with Dr. William Blum, of this bureau, Mr. Barrows recently visited a number of plants and received much valuable information and samples of both satisfactory and defective products. All the manufacturers visited expressed their willingness to cooperate in this investigation.

The exact course of the researches will depend upon the information derived from the preliminary study now in progress. The indications are that numerous factors may be involved, such as porosity of the cast or rolled metal, or variations in the methods of cleaning, plating, rinsing, "oxidizing," and lacquering the articles, or in the nature of the materials used in wrapping, or in the conditions of storage exposure or use. A considerable period will undoubtedly be required to determine the relative effects of each of these possible factors.

In order that this investigation may be made as comprehensive as possible, the bureau will be glad to receive typical samples of spotted products, with full information regarding their origin and history.

When additional funds are available the American Electroplaters' Society expects to support additional researches on electroplating at the Bureau of Standards.

GLUE AS BEATER SIZING

During the World War the shortage of rosin and of the better grades of paper-making materials in Europe led to the development of processes involving the use of glue in the beating-engine stage of paper manufacture. It has been claimed that through such uses of glue paper could be rendered water resistant or sized, as is ordinarily done with rosin, and that papers made from cheaper raw materials, including rather large proportions of mineral filler, would be materially improved in strength and other desirable qualities. The processes referred to generally involve the use of aluminum compounds to jell the glue solution before its use.

Certain paper manufacturers in this country ordinarily use glue in conjunction with rosin sizing to impart special characteristics to their products. This

use of glue has not become more common because under some conditions glue causes excessive foaming in the beating engine. When this occurs, a large proportion of the glue remains in solution and is lost in the waste water from the paper-making machine.

The possibility of improving certain desirable qualities of papers and in this way extending the use of cheaper paper-making materials, such as reclaimed papers and mineral fillers, has led to a study of the use of glue in the beating engine by the bureau in cooperation with the Glue Research Corporation (see T. N. B. No. 106, p. 5, and T. N. B. No. 115, p. 5). This study included consideration of several glue-jelling agents, comparisons of jelled glue and glue solutions, the use of different kinds of pulps and of several grades of glue, as well as several modifications of the paper-beating procedure.

It has been found that the jelling of the glue before adding it to the beater offers no advantages over the use of glue solutions, but that if good retention of the glue in the finished paper is to be obtained the hydrogen-ion concentration or active acidity of the beater contents must be carefully controlled. By regulating the addition of alum to the beater, so that the water from the paper machine has an acidity of about 4.5 (pH), the foaming during the beating and subsequent operations is reduced to a minimum. Also, at this acidity, the retention of glue in the finished paper is generally at its maximum. The retentions of glue compare favorably with those of clay filler under similar conditions. Optimum operating conditions are obtained by furnishing the paper-making materials to the beater in the following order—pulp, filler (if used), rosin size, alum, glue, the glue being added about one hour before the beating is completed.

Experimental papers containing glue without rosin size, when dried on the cylinders of the paper-making machine, were found to be unsized (waterleaf). Similar papers, when air dried at room temperatures, were found to be only slightly sized and unfitted for writing purposes. These papers vary but little in strength qualities from similar waterleaf papers made without glue, although the glue-containing papers do seem harder and firmer than the others.

In papers containing both glue and rosin, the strength is frequently, and the degree of sizing is generally, improved as compared with similar papers when sized with rosin alone. The chief influence of the glue on various types of paper seems to be to improve such intangible properties as firmness, hardness, rattle, and handling qualities. In these respects, experimental sulphite writing papers containing glue seem to approach rag-content bond qualities rather than those of commercial sulphite papers. The improvements in strength qualities, degree of sizing, and the intangible qualities just noted are especially marked in book papers containing clay filler.

A complete report of this work is given in an article, Glue as beater sizing, published in the January 20, 1927, issue of Paper Trade Journal.

LETTER-CARRIER SATCHELS

A conference was held at the bureau, January 19, at which representatives of the Post Office Department, tanners of bag leather, and manufacturers of bags were present. The purpose of this conference was to discuss the construction of letter-carrier satchels and the quality of the leather used.

As to construction of the bags, suggestions were made that a lap be allowed in the welting which is stitched between the sides and gussets instead of requiring that it be one continuous piece. Further suggestion related to a different type of shoulder strap which would eliminate considerable hardware. In the case of the present shoulder strap, which requires an expensive fastening device which outwears the strap, it would appear to be more economical to attach the fastening device to the bag permanently instead of purchasing a fastening device with each strap required for renewals.

With reference to the leather used, it was considered that the proposed Government specification for bag leather

would adequately cover the quality desired with the exception of details, which should be included in the specification for satchels. Previous difficulties in regard to the leather were held to be the result of purchasing leather at a price consistent with the value of the contract rather than according to certain standards.

As a result of this conference, suggestions made as to construction apparently will effect a considerable annual saving. The use of leather in accordance with the specification requirements would effect eventual economy in the longer life of the satchel. In addition, a better understanding of the requirements of the Government on this item was obtained by the commercial interests.

EFFECT OF HUMIDITY AND TEMPERATURE ON TENSILE PROPERTIES OF RUBBER COMPOUNDS

The bureau is cooperating with the American Chemical Society in studying the effect of humidity and temperature at time of test on the tensile properties of rubber compounds. A definite program has been decided upon, and the work is being conducted under the direction of a physical testing committee appointed by the rubber division of the American Chemical Society, the bureau being represented on this committee. A representative of the committee is stationed at the bureau in the capacity of research associate.

The rubber compounds used have been prepared and valcanized under carefully controlled conditions in order to eliminate all variables that might affect the results. The experimental work is being carried on in a constant-temperature room with thermostatic control which permits tests to be made over a temperature range between +4.4° C. (40° F.) and +43.3° C. (110° F.). Samples for test are stored in cabinets which are maintained under atmospheric conditions varying from 0 to 100 per cent relative humidity.

COOPERATIVE STUDY OF RADIO FADING

Radio progress depends upon an increasing knowledge of the vagaries of radio-wave transmission. Radio transmitting and receiving devices have been highly perfected, but received signals are still subject to variations and distortions. In order to secure data on the causes of these variations, the bureau invited a number of university and other laboratories to cooperate in their study. The principal work was the conducting of special radio transmissions from broadcasting stations, during which all the laboratories made simultaneous graphical records of fading.

This work shed a great deal of light on the nature of radio-transmission phenomena. From the results it was possible to determine the dependence of fading on distance, frequency, and other conditions. The fluctuations known as fading are extremely great, and, in addition, there is a wide variation in the average field intensities received from night to night. However, there was discovered one type of regularity in the average intensity of fading signals which had not previously been suspected. This was a definite relation of the ratio of average night to day intensity. This relation was found to have important theoretical bearing in explaining the difference between day and night time transmission conditions.

The results lent new corroboration to the hypothesis that fading and nighttime transmission of radio waves to great distances are due to the action of a conducting surface high in the atmosphere. This hypothesis had been published by the bureau in 1921, as a result of some fading observations made at that time. The characteristic fading observed at considerable distances is found to be caused by variable absorption in the upper atmosphere, and the relatively fast fading is largely the result of interference between the wave transmitted along the ground and the wave which has traveled via the upper conducting surface in the atmosphere. One interesting result is that there was little correlation found between radio reception conditions and weather.

This work was accompanied by a number of special studies. Measurements

made upon received signals at very high frequencies (short waves) showed that the transmission was, in general, irregular, and that the portions of the day for best transmission were markedly different for different frequencies. A study of the effects of high-powered broadcasting was made. It was determined that fading, when expressed as percentage fluctuation, is not different for different amounts of power, but that the area reached with signals of a given intensity is approximately proportional to the power. This work on radio-wave phenomena involved design and construction of apparatus for measuring field intensities and fading. One of the devices was a portable set for measuring field intensities of broadcasting stations, designed to meet the particular needs of the Radio Inspection Service. Measurements made with such an apparatus are the best means of determining the actual radiating power of a broadcasting station.

WEIGHTS AND MEASURES LAWS

There will soon be published by the Bureau of Standards a new compilation of laws of all the States, Territories, insular possessions, and of the Federal Government of the United States.

This compilation includes the weights and measures laws passed by Congress and the regulations issued thereunder by the bureaus concerned, and the weights and measures laws of the various States, Alaska, District of Columbia, Hawaii, Philippine Islands, and Porto Rico. It shows the existing law on the subject through the 1925 sessions of the legislatures. The Federal laws and regulations are given first, and then the laws of the various States, Territories, and possessions in alphabetical order. An appendix gives the weights per bushel of various commodities, as fixed by law. The dates of enactment of the laws or when last amended are shown as far as they have been found.

The subject matter includes the Federal laws and regulations relating to the fundamental standards of the United States; Federal laws requiring the marking of the net weight on packages containing food; standard containers for grapes and other fruits and vegetables; standard barrels for lime and for fruits and vegetables and other dry commodities; State standards of weights and measures, definitions of units of length, area, and mass; net-weight laws relating to the marking of the net contents on packages as required by the States; laws governing the inspection of weights and measures, the officials responsible for the administration of the weights and measures laws, their powers, duties, and obligations relating to the enforcement of the laws, the use of proper weights and measures and weighing and measuring devices, and the condemnation or confiscation of apparatus not conforming to the laws and regulations. Laws relating to boxes, barrels, bales, bags, and other containers used for various commodities, such as apples, berries, flour, fruits, vegetables, fertilizers, grain and mill products, feeding stuffs, etc., as well as laws relating to the sale of numerous other commodities, legal rules for the measurement of flowing water, hay, and logs, and the use of the Babcock test for milk and cream, are included in the compilation.

This publication should be very useful to manufacturers and shippers of package goods in interstate commerce, manufacturers of weights and measures apparatus, weights and measures officials and others concerned with law enforcement, weighing and inspection bureaus, railroad and other officials concerned with weights and measures, lawyers, and reference libraries, etc.

It is estimated that the finished work will contain 1,000 pages or more and will be sold by the Government Printing Office at the usual nominal charge for Government publications, which is intended to cover only the actual cost of paper, presswork, and binding.

A comprehensive subject index makes the compilation most useful and convenient for reference. It is the only publication in its field, and has been critically compiled so as to present the law as it now exists.

It is proposed to print only one edition, limited to meet the immediate demands, and those desiring to obtain a

copy should make their wants known at once. Please do so by writing to the Bureau of Standards, Division of Weights and Measures, Washington, D. C. You will be notified when the book will be ready and the price at which it may be had. Every effort will be made to supply all persons making such requests.

STATE PURCHASING BY SPECIFICATION

Among samples tested recently by the bureau's chemistry division were two delivery samples of glue from the State of Illinois. They were bought on specifications suggested by the bureau after the testing of samples of glue which the State purchasing office knew to be satisfactory. Purchasing officers in two or three other States have not yet seen fit to follow the bureau's suggestion that they adopt the Federal specifications for carbon paper and typewriter ribbons. They still make awards on samples which are sent to the bureau for test. During the month the bureau tested bid samples of ribbons and carbon paper for one of these States.

POSSIBLE POISONING FROM CARBON PAPER

A sample of carbon paper from the War Department was given a special examination by the bureau because of the suspicion that it had caused the death of one man and the serious illness of another by septic poisoning. No evidence was found of the presence of soluble acid, alkali, or other irritating substances, including ferrocyanide or ferric cyanide from the Prussian blue toner. The Bureau of Labor Statistics sent to the Bureau of Standards the record of one case of poisoning said to have been caused by carbon paper. Septic poisoning is due to bacterial infection, which might occur if the skin were irritated by chemical poisons. The paper itself might thus be the indirect cause of septic poisoning. Thousands of people use carbon paper, yet practically none of them complain about any dermatitis or other trouble caused by it. This would seem to indicate some other cause of the cases cited.

NEW PUBLICATIONS

Additions to Supplementary List of Publications of the Bureau of Standards (beginning July 1, 1926).

Scientific Papers[1]

S537. Formula for the inductance of a helix made with wire of any section; Chester Snow. Price, 25 cents.

S538. Spectral energy distribution of the light emited by plants and animals; W. W. Coblentz and C. W. Hughes. Price, 10 cents.

S539. Radiometric measurements on the carbon arc and other light sources used in phototherapy; W. W. Coblentz, M. J. Dorcas, and C. W. Hughes. Price, 15 cents.

S541. A review of the literature relating to the critical constants of various gases; S. F. Pickering. Price, 15 cents.

Technologic Papers[1]

T331. High silicon structural steel; H. W. Gillett. Price, 15 cents.

T332. Statical hysteresis in the flexure of bars; G. H. Keulegan. Price, 10 cents.

T333. Transmision of sound through voice tubes; E. A. Eckhardt, V. L. Chrisler, P. P. Quayle, and M. J. Evans. With a note on the absorption in rigid pipes, by E. Buckingham. Price, 15 cents.

Circulars[1]

C17 (4th ed.). Magnetic testing. Price, 15 cents.

C314. United States Government master specification for ash, soda. Price, 5 cents.

C316. United States Government master specification for soda, laundry (washing soda). Price, 5 cents.

[1] Send orders for publications under this heading, with remittance, only to Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States); 40 cents (foreign).

C317. United States Government master specification for sodium carbonate, granular (monohydrate crystals). Price, 5 cents.

Simplified Practice Recommendations [1]
(Elimination of Waste)

R12 (1st revision). Hollow building tile. Price, 5 cents.

R43. Paint and varnish brushes. Price, 5 cents.

R53. Steel spiral rods (for concrete reinforcement). Price, 5 cents.

Miscellaneous Publications [1]

M75. Nineteenth national conference on weights and measures (May 25 to 28, 1926). Price, 60 cents.

Technical News Bulletin [1]

TNB118. Technical News Bulletin, February, 1927.

OUTSIDE PUBLICATIONS [2]

Burette consistometer. Winslow H. Herschel and Ronald Bulkley; Industrial and Engineering Chemistry, Vol. 19, p. 134; January, 1927.

Performance characteristics of journal bearings when an abrasive is in the lubricant. S. A. McKee; J. Society of Automotive Engineers, Vol. 20, No. 1, pp. 3–6; January, 1927.

Some factors that affect the frictional properties of automobile brake linings. H. H. Allen; J. Society of Automotive Engineers, Vol. 20, No. 1, pp. 77–82; January, 1927.

Fire intensity tests by the Bureau of Standards. (From Technical News Bulletin items for October and December, 1926, with illustrations.) Safety Engineering, Vol. 53, No. 1, pp. 29–35; January, 1927.

Fire tests of office occupancies. (Illustrated item from Technical News Bulletin for December, 1926.) Quarterly, National Fire Protection Association, Vol. 20, No. 3, pp. 243–252; January, 1927.

Progress in study of normal and abnormal steel. S. Epstein and H. S. Rawdon; Preprint of paper presented before American Society for Steel Treating, January 20 and 21, 1927.

Iron-carbon-vanadium alloy for Brinell balls. G. W. Quick and L. Jordan; Preprint of paper presented before American Society for Steel Treating, January 20 and 21, 1927.

Observations on phosphorus in wrought iron. H. S. Rawdon and Samuel Epstein; (Abstract); Iron and Steel of Canada, Vol. 9, p. 282; 1926.

Report of subcommittee VII of committee A–5 on accelerated corrosion tests. H. S. Rawdon, Chairman; Proceedings, American Society for Testing Materials, Vol. 26, Part 1, p. 144; 1926.

Etching solutions for carbides, etc., in alloy steels. E. C. Groesbeck; Proceedings, American Society for Testing Materials, Vol. 26, Part 1, p. 569; 1926.

Report of subcommittee V of committee E–4 on microhardness. H. S. Rawdon, chairman; Proceedings, American Society for Testing Materials, Vol. 26, Part 1, p. 572; 1926.

Methods of tests in relation to flow in steels at various temperatures. H. J. French; Proceedings, American Society for Testing Materials, Vol. 26, Part 2, p. 7; 1926.

Note on the protection of iron by cadmium. H. S. Rawdon; Transactions, American Electrochemical Society, Vol. 49, p. 339; 1926.

Written discussion (flow of metals at high temperatures) with curves giving Bureau of Standards data. H. J. French; Transactions, American Society for Steel Treating, Vol. 11, p. 95; 1927.

Regularities in the arc spectrum of lanthanum. W. F. Meggers; Journal Washington Academy of Sciences, Vol. 17, p. 25; 1927.

[1] Send orders for publications under this heading, with remittance, only to Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States); 40 cents (foreign).

[2] "Outside publications" are not for distribution or sale.

Spectra excited by active nitrogen. A. E. Ruark, P.D. Foote, Philip Rudwich, and R. L. Chenault; Journal, Optical Society of America and Review of Scientific Instruments, Vol. 14, p. 17; 1927.

Electron collisions in carbon monoxide. F. L. Mohler and P. D. Foote; Physical Review, Vol. 29, p. 141; 1927.

X-ray protective plasters. F. L. Hunt; Radiology, Vol. 8, p. 117; 1927.

The wonderland of new materials. George K. Burgess; Factory, Vol. XXXVIII, No. 1, p. 196; January, 1927.

Work of the Bureau of Standards in 1926 on lime, gypsum, and sand-lime brick. Lime and Gypsum section's staff; Rock Products, p. 59; January 8, 1927.

A wet-rub tester for paper. F. T. Carson and F. V. Worthington; Paper Trade Journal, Vol. 84, No. 2, p. 45; January 13, 1927.

Glue as beater sizing. G. K. Hamill, M. B. Shaw, and G. W. Bicking; Paper Trade Journal, Vol. 84, No. 3, p. 38; January 20, 1927.

Radio signal strength and temperature. L. W. Austin and I. J. Wymore; Proceedings, Institute of Radio Enginers, December, 1926.

How "world's biggest business" spends $300,000,000 yearly. N. F. Harriman; Forbes, Vol. XIX, No. 3, p. 19; February 1, 1927.

WASHINGTON: GOVERNMENT PRINTING OFFICE: 1927